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ABSTRACT

A project was conducted to develop assessment instruments for the living technology (LT) teacher certification examination in Taiwan. Living technology is a secondary-level comprehensive experiential program that addresses technology, its evolution, applications, and impacts. During the project, LT teacher competencies were identified and verified, and secondary-school LT technology teacher certification examination approaches were identified. Both DACUM (Developing a Curriculum) and Delphi approaches were used to identify and verify a job file for secondary LT teachers. Eight duties and 46 tasks were identified, and competency-based certification examination approaches were described. The development process and standards created were somewhat similar to the Ohio model curriculum standards, which are also competency-based. In addition to aiding the development of assessment instruments, the job profile can be used as a tool for developing curriculums, creating teacher examinations, reviewing programs, recording progress, and assisting in career development of persons in the field of technology teacher education in Taiwan. (Author/KC)

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Development of Technology Teacher Certification Examination in Taiwan

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Abstract

Sponsored by the National Science Council (NSC), this author has led a project team to develop assessment instruments for the living technology (LT) teacher certification examination in Taiwan. Employing both DACUM and Delphi approaches, the team identified and verified a job file for secondary-school LT teachers, including eight duties and 46 tasks, and its competency-based certification examination approaches. In addition to aiding the development of assessment instruments, the job profile may serve as a tool/instrument for developing curricula, creating teacher examinations, reviewing programs, recording progress, and assisting in career development of individuals in the field of technology teacher education.

Development of Technology Teacher Certification Examination in Taiwan

Background and Purpose

The schooling system in Taiwan consists of six years of elementary school and six years of secondary school education (including three years of junior high school education and three years of high school education). Subject-specific school teachers are normally certified at two levels, elementary and secondary. There are two reasons for developing a secondary-level technology teacher certification examination in Taiwan:

1. Living technology (LT) teachers in junior-high schools have to broaden their specialties

In Taiwan, technology education, called "living technology" (pronounced *Sheng-hwo Ke-jih* in Mandarin Chinese) and focusing on enhancing pupils' technological literacy, is offered in grades 1-11. Appendix 1 presents the technology education currently in the national curricula. In 1997, the Ministry of Education (MOE) began to amend the national curriculum syllabus for grades 1-9 in response to the call for educational reform in terms of the articulation, integration and flexibility of curricula. The tentative syllabus, which included seven key learning areas (KLA's), was announced in September 2000 and took effect in the academic year of 2001. In this new national curriculum, Living Technology (LT) and Natural Science (NS, including biology, physics, chemistry and earth science) are integrated into a KLA called "Natural Science & Living Technology" (NS&LT). However, the three KLA's—NS&LT, Social Studies and Arts & Humanities—are integrated into a broader area called "Living" (pronounced *Sheng-hwo* in Mandarin Chinese) for 1st and 2nd grades students.

The expected student competency indicators for each KLA are specified in the national curriculum syllabus for grades 1-9. In NS&LT, there are at least 33 indicators pertaining to LT. Thematic or unit instruction is strongly suggested in the syllabus. Thus, the following three types of units will coexist in the KLA of NS&LT: (1) single-subject units, such as the unit "land transportation," mainly derived from the traditional subject, LT; (2) cross-subject units, such as the unit "environmental protection," obviously derived from more than one traditional subject, LT, Biology, Chemistry, etc.; and (3) para-subject units, such as the unit "learning skills," primarily derived from one or more traditional subject(s) and non-traditional areas.

As a result of the emerging national curriculum for grades 1-9 and its NS&LT KLA,

the visibility of technology education will increase, and hopefully, the partnership between science and technology (S&T) will be promoted. However, many areas, such as teacher training and re-training, exemplar programs, teaching materials, and instructional strategies, need to be developed.

After the national curriculum for grades 1-9 was promulgated, the MOE began to revise the present certification requirements for elementary- and junior-high-school teachers. The specialty course areas newly proposed for junior-high-school NS&LT teachers are shown in Figure 1. A prospective NS&LT teacher, trained in a technology teacher program, has to take 22 core semester credits in the field of NS&LT and 22 semester credits in the field of LT.

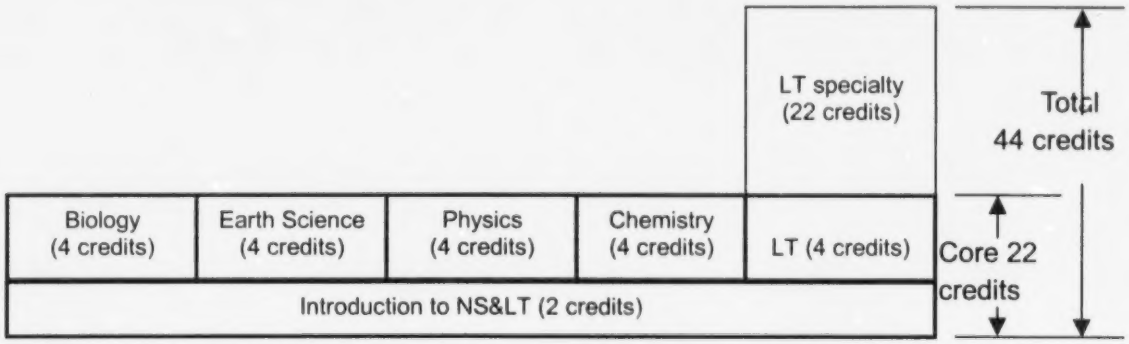

Figure 1. The specialty course areas newly proposed for junior-high-school NS&LT teachers.

2. The teacher certification procedure will be changed soon

The technological literacy needed by pupils, technology education in schools, and technology teacher education are all parts of a value chain. They are interdependent. In Taiwan, almost all teachers in elementary schools are graduates of one of Taiwan's nine public teacher colleges, while most teachers in junior and senior high schools are graduates of one of the following three normal universities—National Taiwan Normal University, National Changhua University of Education, and National Kaoshiung Normal University. However, any university in Taiwan can offer a teacher education program if it applies and passes an evaluation. At present, there are many recognized university programs for elementary- and secondary-school teacher preparation.

As shown in Figure 2, those students who graduate from a university/college and complete a teacher education program offering liberal arts, specialty, and pedagogical courses, are qualified to become interns. They can receive a teacher's license after

passing an assessment of their one-year internship. Only licensed teachers can be formally employed by schools. Both initial and final certifications are based on a review of the applicant's transcript.

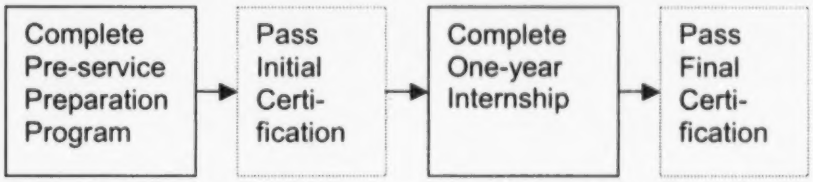

Figure 2. The preparation and certification procedure of school teachers in Taiwan.

The MOE is revising the regulations for the qualification and preparation of school teachers. A substantial amount of testing will be added to the initial certification shown in Figure 2. In addition, the one-year internship will be shortened to a half year.

In order to reflect the above changes in both the national curriculum and the teacher certification process, LT teacher competencies should be identified and verified. Accordingly, the purposes of this study were: (1) to identify and verify secondary-school LT teacher competencies, and (2) to identify secondary-school LT technology teacher certification examination approaches. This paper describes the process and results of the above identification and verification efforts.

Methodology and Procedure

Secondary-school technology education is a comprehensive experiential program that addresses technology, its evolution, applications and impacts. Thus, technology teachers need very high level liberal, technical and pedagogical competencies. For example, in terms of technical and pedagogical competencies, the State of Washington requires its technology teachers to demonstrate the following nine competencies: (1) knowledge and understanding of systems and concepts related to all areas of technological study referred to as core technologies, including: power and energy, controls, materials science, problem solving, and technology in society; (2) knowledge and understanding of the relationship of mathematics, science, computer science, and communications to the technological process; (3) competency in the areas of communications, manufacturing, construction, transportation, and bio-related fields with a concentration in at least one of the areas; (4) the ability to manage a traditional shop as well as to convert a traditional shop into an exemplary technology education

laboratory; (5) knowledge and understanding of communications and technological concepts related to technical systems created for encoding, transmitting, receiving, decoding, storing, retrieving, and using information; (6) the fundamental knowledge of manufacturing and manufacturing systems and technological concepts related to technical systems associated with research, extraction, processing, recycling, and conversion of materials for consumer and industrial goods; (7) fundamental knowledge of construction and construction systems, including technological concepts related to technical systems associated with the design, creation, maintenance, and construction of residential, commercial, industrial, and civil structures as well as economics, management, power, and energy; (8) knowledge and understanding of transportation systems, including technological concepts related to technical systems associated with the design, development, evaluation, and operation of subsystems, and components of terrestrial, marine, atmospheric, and space vehicles; and (9) knowledge and understanding of biological systems in areas such as botany, environmental biology, medicine, biotechnology and zoology (Washington State Code Reviser's Office, 1998). As another example, the teacher education standards in Ohio underwent revision in 1992, and new performance-based licensure standards were adopted and became effective in 1998. The latest standards emphasize the performance of institutions and require new teachers, supported through an entry year program, to pass a state performance assessment to move from a two-year provisional license to a five-year renewable professional license. The standards are in line with what teachers "need to know" and need to "be able to do" based on Ohio model curriculum standards for pre-kindergarten through grade 12 students and national content and teacher preparation standards (Ohio State Department of Education, 2001). That is to say, competency- or performance-based approaches are often found in teacher certification and education.

The identification and verification of secondary-school LT teacher competencies in Taiwan should proceed both globally and locally. Competency can be considered to include knowledge, attitude and skill (KAS) or be broadened to include holistic learning outcomes. A competency chart, often called a job profile, is normally developed when the competencies of a job are identified. A job profile can be used for a variety of purposes: (1) as a tool to determine the level of competency of the individual before training, (2) as an instrument for recording progress in improving competency, (3) as a sheet for recording target competency profiles, (4) as an applicant's self assessment when he/she is applying for a position, (5) as a sheet appended to position descriptions,

(6) as a competency description to aid skilled performers, (7) as a display and analysis tool for planning training, and (8) as an individual profile serving as a certification document (Adams, 1995).

Under the sponsorship of the National Science Council (NSC) and with the goal of developing assessment instruments for LT teacher certification testing, this study employed the DACUM approach to identify a job profile of secondary-school LT teachers and utilized the Delphi method to verify the profile along with further competencies as described in the following.

1. Identification stage—DACUM was employed

The criteria for determining successful LT teachers were drafted and discussed. Finally, training background, teaching experience, professional reputation, and school location were listed as four main criteria. Based on these criteria, 10 secondary-school LT teachers were selected to participate in a two-day DACUM workshop in May 2001 to identify a job profile.

2. Verification stage—Delphi was utilized

In this stage, 10 technology teacher educators having secondary-school teaching experience were selected to serve as Delphi panelists. A questionnaire was developed from the job profile and included competencies and possible examination approaches, following each task in the profile. All the panelists were requested to verify the importance of each competency on a five-point Likert scale and to choose two appropriate examination approaches for each competency from among the following six options: pencil-and-paper test, interview, practicum, simulation, portfolio, and other. Three rounds of surveys were conducted between September 2001 and December 2001. Subsequently, seven panelists completed the three rounds and were considered valid respondents.

Findings and Conclusions

1. The identified job profile has multiple purposes

The identification of LT teacher competencies resulted in the LT job profile shown in Appendix 2. The profile includes eight duties (Duties A-H) and 46 tasks (Tasks A1-H6), tools and equipment used, general knowledge and skills needed, demonstrated attitudes and traits, and future trends and concerns in the secondary-school LT teaching profession. It is concluded that the job profile can be utilized to develop assessment instruments, to develop future LT teacher preparation curricula, to review present LT

teacher education programs, to record prospective LT teachers' progress, and to assist prospective/in-service LT teacher career development.

2. The verified competencies and identified examination approaches are now being employed to develop LT teacher certification examination plans

The Delphi results are shown in Tables 1 to 8. Means above 4.2 on the five-point scale, and the approach(es) most often selected are highlighted in shadow type.

The results are now being employed to develop LT teacher certification examination plans which will be completed by the end of 2002. In addition to being utilized to develop assessment instruments, the job profile may serve as a tool/instrument for developing curricula, creating teacher examinations, reviewing programs, recording progress, and assisting in career development of individuals in the field of technology teacher education.

Table 1.

Competencies in Duty A--Lab Planning and Management.

			Examination Approaches					
Tasks and Competencies	**M**	**STD**	**Pe**	**I**	**Pr**	**S**	**F**	**O**
A1 Conduct Needs Assessment	**3.9**	**0.350**	**6**	**2**	**1**	**0**	**3**	**0**
A11 Identify needs	3.9	0.639	6	3	1	0	2	0
A12 Assess strengths and weaknesses	4.0	0.535	6	4	0	0	2	0
A2 Prepare a Proposal	**3.7**	**0.452**	**6**	**4**	**0**	**0**	**1**	**0**
A21 Generate ideas	3.7	0.452	6	3	1	0	1	0
A22 Complete documentation	3.7	0.452	6	4	0	0	3	0
A3 Plan Space and Aisles	**4.6**	**0.495**	**3**	**1**	**1**	**5**	**1**	**0**
A31 Plan space	4.4	0.495	4	1	2	4	1	0
A32 Plan Aisles	4.6	0.495	4	1	1	5	1	0
A4 Plan and Prepare Layout for Equipment	**4.6**	**0.495**	**4**	**2**	**1**	**5**	**1**	**0**
A41 Plan machines and equipment	4.4	0.495	4	1	1	6	1	0
A42 Prepare layout for machines and equipment	4.4	0.495	5	1	0	6	1	0
A5 Plan and Prepare Layout for Health and Safety facilities and Equipment	**4.6**	**0.495**	**5**	**1**	**0**	**5**	**1**	**0**
A51 Plan health and safety facilities and equipment	4.6	0.495	5	1	0	5	1	0
A52 Prepare layout for health and safety facilities and equipment	4.4	0.495	4	1	0	6	1	0
A6 Manage and Maintain Facilities and Equipment	**4.3**	**0.452**	**5**	**3**	**3**	**0**	**1**	**0**
A61. Manage facilities and equipment	4.4	0.495	5	3	3	0	1	0
A62. Maintain facilities and equipment	4.3	0.452	5	3	3	0	1	0
A7 Manage Safety and Health of Operation	**4.6**	**0.495**	**4**	**3**	**1**	**1**	**2**	**0**

A71. Manage operation safety	4.9	0.350	3	3	1	2	1	0
A72. Manage operation health	4.6	0.495	4	4	1	1	1	0
A8 Manage Supplies and Handle Waste	**4.6**	**0.495**	**3**	**3**	**1**	**3**	**1**	**0**
A81. Manage supplies	4.3	0.700	4	4	0	2	1	0
A82. Handle wastes	4.4	0.495	3	3	1	3	1	0
A9 Develop Lab Usage and Management Regulations	**4.7**	**0.452**	**5**	**2**	**0**	**1**	**2**	**0**
A91. Develop lab usage regulations	4.4	0.728	5	2	0	1	3	0
A92. Develop management regulations	4.4	0.495	5	2	0	1	3	0

Note: I—Interview, F—Folio, M—Mean, O—Other, Pe—Pencil-and-Paper, Pr—Practicum, STD—Standard Deviation, S—Simulation.

Table 2.

Competencies in Duty B--Instructional Preparation.

			Examination Approaches					
Tasks and Competencies	**M**	**STD**	**Pe**	**I**	**Pr**	**S**	**F**	**O**
B1. Become Familiar with Instructional Materials and Methods	**4.9**	**0.350**	**2**	**5**	**2**	**0**	**3**	**0**
B11.Comprehend multiple instructional materials	5.0	0.000	0	5	3	0	4	0
B12. Become familiar with various instructional methods	4.9	0.350	0	6	4	0	2	0
B2. Realize Students' Initial Behaviors	**4.6**	**0.495**	**2**	**6**	**2**	**0**	**2**	**0**
B21.Realize students' learning experiences	4.3	0.700	2	5	2	1	1	0
B22.Realize students' individual needs	4.6	0.495	2	5	2	1	1	0
B3. Prepare Instructional Resources	**4.9**	**0.350**	**1**	**5**	**5**	**0**	**1**	**0**
B31.Prepare instructional media	4.7	0.452	1	5	5	0	1	0

B32.Prepare instructional handouts	4.7	0.452	1	5	5	0	1	0
B33.Prepare the instructional environment	4.7	0.452	1	5	5	0	1	0
B4. Establish Assessment Standards	**4.9**	**0.350**	**4**	**3**	**0**	**2**	**3**	**0**
B41.Establish teacher standards	4.7	0.452	4	2	2	1	3	0
B42.Establish student standards	4.7	0.452	4	2	2	1	4	0

Note: I—Interview, F—Folio, M—Mean, O—Other, Pe—Pencil-and-Paper, Pr—Practicum, STD—Standard Deviation, S—Simulation.

Table 3.

Competencies in Duty C--Instructional Implementation.

			Examination Approaches					
Tasks and Competencies	**M**	**STD**	**Pe**	**I**	**Pr**	**S**	**F**	**O**
C1 Direct Appropriate Operations	**4.9**	**0.350**	**1**	**1**	**6**	**2**	**1**	**0**
C11. Identify tools, machines and equipment	4.9	0.350	2	2	7	1	1	0
C12.Demonstrate the operation of tools and machines	4.9	0.350	1	2	6	3	1	0
C13.State safety precautions for using tools and machines	4.9	0.350	1	2	7	2	1	0
C2 Manage Learning Objectives and Progress	**4.7**	**0.452**	**2**	**2**	**2**	**0**	**3**	**0**
C21.Manage learning goals	4.7	0.452	3	2	2	0	4	0
C22.Manage learning progress	4.6	0.495	2	3	2	0	4	0
C3 Apply Appropriate Instructional Methods	**4.9**	**0.350**	**2**	**2**	**4**	**2**	**2**	**0**
C31.Determine instructional objectives	4.9	0.350	2	6	1	1	2	0
C32.Apply instructional approaches	4.7	0.452	1	3	4	3	2	0
C4 Conduct Learning Assessment	**4.9**	**0.350**	**2**	**4**	**1**	**3**	**1**	**0**
C41. Determine assessment objectives	4.6	0.495	4	4	1	1	1	0

C42.Apply assessment approaches	4.7	0.452	2	4	2	2	1	0

Note: I—Interview, F—Folio, M—Mean, O—Other, Pe—Pencil-and-Paper, Pr—Practicum, STD—Standard Deviation, S—Simulation.

Table 4.

Competencies in Duty D--Instructional Assessment.

			Examination Approaches					
Tasks and Competencies	**M**	**STD**	**Pe**	**I**	**Pr**	**S**	**F**	**O**
D1. Develop and Apply Assessment Instruments	**4.9**	**0.350**	**2**	**5**	**4**	**0**	**1**	**0**
D11.Develop assessment instruments	4.7	0.452	4	4	3	0	1	0
D12.Apply assessment instruments	4.9	0.350	4	4	2	0	2	0
D2. Develop Assessment Battery	**3.9**	**0.639**	**3**	**2**	**0**	**1**	**5**	**0**
D21.Develop batteries	3.9	0.639	2	2	0	2	5	0
D22.Renew and maintain batteries	3.7	0.452	3	2	0	1	5	0
D3. Apply Multiple Assessment Methods	**4.3**	**0.452**	**1**	**4**	**0**	**1**	**5**	**0**
D31.Apply multiple assessment concept	4.4	0.495	4	4	0	1	2	0
D32. Apply multiple assessment approaches	4.3	0.452	1	4	0	1	5	0
D4. Analyze and Apply Assessment Results	**4.6**	**0.495**	**1**	**3**	**4**	**1**	**2**	**0**
D41.Analyze results	4.3	0.452	1	3	5	0	2	0
D42.Apply results	4.7	0.452	1	5	3	1	1	0
D5. Provide assessment Feedback	**4.6**	**0.495**	**2**	**5**	**3**	**0**	**1**	**0**
D51.Determine feedback objectives	4.4	0.495	3	5	1	0	2	0
D52.Apply feedback approaches	4.6	0.495	2	5	3	0	1	0

Note: I—Interview, F—Folio, M—Mean, O—Other, Pe—Pencil-and-Paper, Pr—Practicum, STD—Standard Deviation, S—Simulation.

Table 5.

Competencies in Duty E—Curriculum Development.

			Examination Approaches					
Tasks and Competencies	**M**	**STD**	**Pe**	**I**	**Pr**	**S**	**F**	**O**
E1. Determine Course Goals	**3.7**	**0.700**	**3**	**4**	**0**	**0**	**3**	**0**
E11.Determine goal sources	3.6	0.728	5	4	0	0	2	0
E12.Analyze goals	3.7	0.452	3	4	0	0	4	0
E2. Participate in Curriculum Planning	**4.1**	**0.639**	**3**	**5**	**0**	**0**	**3**	**0**
E21.Indentify prerequisite skills	4.1	0.639	4	5	0	0	2	0
E22.Take positive actions	4.1	0.639	2	6	0	0	3	0
E3. Develop Program of Study and Content	**4.1**	**0.639**	**2**	**5**	**1**	**0**	**3**	**0**
E31.Indentify content	4.1	0.639	1	6	1	0	3	0
E32.Develop curriculum plan	4.1	0.639	1	5	1	0	4	0
E4.Develop Technological Learning Activities (TLA's)	**4.4**	**0.495**	**4**	**4**	**3**	**0**	**1**	**0**
E41.Identify basic skills	4.4	0.495	4	6	1	0	1	0
E42.Design TLA's	4.6	0.495	3	3	3	1	2	0
E5. Establish Curriculum Evaluation Mechanism	**3.7**	**0.700**	**1**	**4**	**0**	**0**	**5**	**0**
E51.Conduct self-evaluation	3.7	0.700	1	4	0	0	5	0
E52.Involve administration, community parents and students in evaluation	3.7	0.700	1	3	0	0	4	1

Note: I—Interview, F—Folio, M—Mean, O—Other, Pe—Pencil-and-Paper, Pr—Practicum, STD—Standard Deviation, S—Simulation.

Table 6.

Competencies in Duty F—Classroom Management.

			Examination Approaches					
Tasks and Competencies	**M**	**STD**	**Pe**	**I**	**Pr**	**S**	**F**	**O**
F1. Establish Student Organization	**4.1**	**0.639**	**2**	**2**	**0**	**2**	**5**	**0**
F11.Establish classroom student organization	4.1	0.639	2	3	0	3	3	0
F12.Promote student autonomy	4.1	0.639	2	3	0	1	5	0
F2. Create Class Portfolios	**4.4**	**0.728**	**1**	**3**	**0**	**3**	**4**	**0**
F21.Creat student data	4.3	0.700	1	3	0	3	4	0
F22.Identify class features	4.3	0.700	1	4	0	1	5	0
F3. Develop Learning Situation	**4.4**	**0.495**	**1**	**2**	**3**	**4**	**1**	**0**
F31.Encourage learning motivation	4.4	0.495	0	2	3	5	1	0
F32.Create positive learning environment	4.7	0.452	0	2	4	3	2	0
F4. Establish Communication Network	**3.9**	**0.350**	**1**	**3**	**2**	**0**	**4**	**1**
F41.Establish teacher-parent-student networks	3.9	0.350	1	3	2	0	4	1
F42.Conduct teacher-parent-student meetings	3.9	0.350	1	3	2	0	4	1
F5. Execute Crisis Management	**4.6**	**0.728**	**1**	**3**	**1**	**5**	**1**	**0**
F51.Manage accidental events	4.4	0.728	1	4	0	4	1	1
F52.Manage crisis prevention	4.4	0.495	1	3	1	3	2	1
F6. Develop Classroom Climate	**4.7**	**0.452**	**1**	**2**	**0**	**3**	**3**	**0**
F61.Conduct class management	4.6	0.495	1	2	0	5	3	0
F62.Develop teamwork spirit	4.3	0.452	0	2	1	4	4	0

Note: I—Interview, F—Folio, M—Mean, O—Other, Pe—Pencil-and-Paper, Pr—Practicum, STD—Standard Deviation, S—Simulation.

Table 7.

Competencies in Duty G—Administration and Service.

			Examination Approaches					
Tasks and Competencies	**M**	**STD**	**Pe**	**I**	**Pr**	**S**	**F**	**O**
G1. Participate in Community Activities	**3.3**	**0.452**	**0**	**4**	**0**	**3**	**3**	**1**
G11.Enable community involvement	3.3	0.452	0	4	0	3	3	1
G12.Conduct community activities	3.3	0.452	0	5	0	1	4	1
G2. Provide Technological Consultation	**3.3**	**0.452**	**1**	**4**	**0**	**0**	**4**	**1**
G21.Provide technological support	3.1	0.350	1	5	0	0	3	1
G22.Provide technological consultation	3.0	0.000	1	4	0	0	4	1
G3. Supervise Students' Extra-curricular Activities	**3.7**	**0.452**	**1**	**4**	**0**	**0**	**5**	**1**
G31.Supervise students' involve public service	3.7	0.452	1	4	0	0	5	1
G32. Supervise students' extra-curricular activities	3.6	0.495	0	3	0	0	7	1
G4. Understand Administrative Procedures	**3.4**	**0.495**	**1**	**6**	**0**	**1**	**2**	**1**
G41.Understand administrative affairs	3.6	0.495	1	6	0	2	1	1
G42.Understand administrative operations	3.6	0.495	1	6	0	1	2	1
G5.Participate in Administrative Affairs	**3.1**	**0.350**	**1**	**4**	**0**	**3**	**2**	**1**
G51.Support administrative work	3.1	0.350	0	5	0	3	2	1
G52.Participate in administrative work	3.0	0.535	0	5	0	3	2	1
G6. Provide Career Consultation	**4.0**	**0.535**	**0**	**5**	**0**	**1**	**3**	**1**
G61.Assist students with career planning	4.0	0.535	0	6	0	1	2	1

G62.Provide students with guidance and consultation	4.0	0.535	0	5	0	1	3	1
G7. Conduct Technological Activities	**3.7**	**0.452**	**0**	**3**	**0**	**3**	**4**	**0**
G71.Plan technology activities	3.7	0.452	0	4	0	3	4	0
G72.Conduct technology activities	3.7	0.452	0	3	0	3	5	0

Note: I—Interview, F—Folio, M—Mean, O—Other, Pe—Pencil-and-Paper, Pr—Practicum, STD—Standard Deviation, S—Simulation.

Table 8.

Competencies in Duty H—Research and Development.

			Examination Approaches					
Tasks and Competencies	**M**	**STD**	**Pe**	**I**	**Pr**	**S**	**F**	**O**
H1. Participate in Professional Groups	**3.7**	**0.452**	**0**	**5**	**0**	**0**	**5**	**0**
H11.Understand professional groups' features	3.7	0.452	0	5	0	0	5	0
H12.Manage professional groups' activities	3.7	0.452	0	5	0	0	5	0
H2. Enhance Professional Development	**4.4**	**0.495**	**0**	**5**	**0**	**0**	**5**	**0**
H21.Enhance professional skills	4.3	0.452	0	5	0	0	4	1
H22.Promote professional development	4.0	0.535	0	5	0	0	4	1
H3. Share Research and Development Results	**3.9**	**0.350**	**3**	**2**	**0**	**0**	**6**	**0**
H31.Compile R&D data	3.6	0.495	3	2	0	0	6	0
H32.Disseminate R&D results	3.7	0.452	3	2	0	0	6	0
H4. Hold Instructional Exhibitions	3.9	0.350	0	1	0	4	6	0
H41. Conduct instructional activities	4.0	0.535	0	1	1	4	5	0
H42. Conduct instructional demonstrations	3.9	0.350	0	2	1	3	5	0
H5. Conduct Action Research	**3.7**	**0.452**	**2**	**6**	**0**	**1**	**1**	**1**

H51. Understand action research features	3.7	0.452	2	6	0	1	1	1
H52. Implement action research	3.9	0.639	1	5	1	1	2	1
H6. Market Technology Education Programs	3.7	0.452	1	4	0	0	5	1
H61. Plan programs	3.7	0.452	1	4	0	0	5	1
H62. Promote programs	3.7	0.452	1	4	0	0	5	1

Note: I—Interview, F—Folio, M—Mean, O—Other, Pe—Pencil-and-Paper, Pr—Practicum, STD—Standard Deviation, S—Simulation.

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Appendix 1. Technology Education in National Curricula

	Elementary School (Grades 1-6)	Junior High School (Grades 7-9)	Senior High School (Grades 10-12)
Subject Title (Beginning Year/Month)	Craftwork (1996/8-)	Living Technology (1997/8-)	Living Technology (1999/8-)
Teaching Period*	Grades 1-2: 2 periods/week Grades 3-6: 3 periods/week	Grades 7-9: 1 semester/ academic year; 2 periods/week	Grades 10-11: 1 semester/ academic year; 2 periods/week
Target Student	All students	All students	All students
Program Goal	To enhance pupils' presentation, appreciation, and practical application abilities. In grades 1-4, the emphasis is on intelligent planning and functional presentation, and in grades 5-6, it is on functional presentation. Thus, in the area of craftwork, the most important part of technology education is the practical application.	To understand technology and its impacts, to apply technological products and means, to understand careers related to technology, to identify pupil's interests and capabilities, and to enhance pupils' adaptability in our technological society.	To understand technology and evaluate its impacts on the individual/social environment and on human civilization, to pursue well-developed technological capabilities and problem-solving competencies, to establish proper technological attitudes, and to enliven interest in technology and studies.

Subject Matter	Use of toys/ clothes/ornaments; application of technological materials; use of tools, etc.; synthesis of perception and creative problem-solving.	Technology and life, information and communication, construction and manufacturing, and energy and transportation.	Technology and life, information and communication, construction and manufacturing, and energy and transportation.
Instructional Focus	Unit teaching; Activity-oriented experimental discovery	Unit teaching; Activity-oriented problem-solving	Unit teaching; Activity-oriented problem-solving
Selected Courses Related to Technology		Occupational Disciplines: 1-3 periods/week for grade 7, and 1-5 periods/week for grade 8; subjects include agriculture, industry, commerce, home economics, marine biology, etc.	Living Technology: 2 periods/week for grade 11, and 2-4 periods/week for grade 12; subjects include graphics, energy and power, and industrial materials.
Remark		Computer classes are required for all 8th and 9th graders, 1 period/week.	Computer classes are available elective courses for 11th and 12th graders, 2 periods/week.

Note : 40, 45, and 50 minutes per period, respectively, for elementary, junior high and senior high school.

Appendix 2. A Job Profile of Secondary-school Living Technology Teacher

Duties	Tasks			
A. Lab Planning and Management	A1. Conduct Needs Assessment	A2. Prepare a Proposal	A3. Plan Space and Aisles	A4. Plan and Prepare Layout of Equipment
	A5. Plan and Prepare Layout of Health and Safety Facilities and Equipment	A6. Manage and Maintain Facilities and Equipment	A7. Manage Safety and Health of Operation	A8. Manage Supplies and Handle Wastes
	A9. Develop Lab Usage and Management Regulations			
B. Instructional Preparation	B1. Become Familiar with Instructional Materials and Methods	B2. Understand Students' Initial Behaviors	B3. Prepare Instructional Resources	B4. Establish Assessment Standards
C. Instructional Implementation	C1. Direct Appropriate Operations	C2. Manage Learning Objectives and Progress	C3. Apply Appropriate Instructional Methods	C4. Conduct Learning Assessment
D. Instructional Assessment	D1. Develop and Apply Assessment Instruments	D2. Develop Assessment Battery	D3. Apply Multiple Assessment Methods	D4. Analyze and Apply Assessment Results
	D5. Provide Assessment Feedback			

E. Curriculum Development	E1. Determine Course Goals	E2. Participate in Curriculum Planning	E3. Develop Program of Study and Content	E4. Develop Technological Learning Activities (TLA's)
	E5. Establish Curriculum Evaluation Mechanism			
F. Classroom Management	F1. Establish Student Organization	F2. Create Class Portfolios	F3. Develop Learning Situation	F4. Establish Communica-tion Network
	F5. Execute Crisis Management	F6. Develop Classroom Climate		
G. Administra-tion and Service	G1. Participate in Community Activities	G2. Provide Technological Consultation	G3. Supervise Students' Extra-curricular Activities	G4. Understand Administrative Procedures
	G5. Participate in administrative Affairs	G6. Provide Career Consultation	G7. Conduct Technological Activities	
H. Research and Development	H1. Participate in Professional Groups	H2. Enhance Professional Development	H3. Share Research and Development Results	H4. Hold Instructional Exhibitions
	H5. Conduct Action Research	H6. Market Technology Education Programs		

Tools & Equipment	
1. Multi-media computer hardware 1.1 Digital camera 1.2 Printer 1.3 Scanner 1.4 TV set 1.5 V8 digital camcorder 1.6 VCD, DVD and VHS video player 1.7 High resolution projector 2. **Multi-media computer software** 2.1 Imagine processing 2.2 CAD 2.3 Video Editing **3. Internet tool software** 3.1 E-mail 3.2 File transfer 3.3 Homepage production **4. Windows software** 4.1 Word processing	4.1 Document layout 4.2 Statistical analysis **4.3** Database **5. Manual drafting tools** Rules, Pencils, etc. **6. Hand tools** Scissors, saws, planers, screw drivers, files, hammers, wrenches, drills, soldering tools, sandpaper, etc. **7. Measurement tools** Multimeter, scale, etc. **8. Desk-top machines** Drill press, saws, grinders, air compressor, etc. **9. Suppliers** Electronics suppliers, photographic materials suppliers, hardware suppliers, etc.

General Knowledge & Skills	Attitudes & Traits	Future Trends & Concerns
1. Knowledge	**1. Attitudes**	**1. Technology and technology education**
1.1 Evolution of technology (history, society and culture)	1.1 Diligent and responsible	1.1 Need more effective technology teaching skills
1.2 Information, manufacturing, construction, transportation, communication, bio-related technologies and their content knowledge	1.2 Cooperative	1.2 Need more technology education program marketing strategies
	1.3 Self-confident	1.3 Faster technology curriculum change
	1.4 Creative thinking	1.4 Faster technological change
	1.5 Good human relationships	**2. Teacher professional skills**
	1.6 Critical thinking	2.1 Need to strengthen knowledge learning skills
	1.7 Reasonable emotion management	2.2 Need to enhance action
1.3 Technological concepts (common sense and news)	**2. Traits**	
1.4 Instructional design and integration	2.1 Positive reaction to technological artifacts	
	2.2 Active application of technology	
	2.3 Proactive analysis of	

1.5 Curriculum concepts and development 1.6 Scientific principles and their applications 1.7 Mathematical applications and calculations **2. Skills** 2.1 Problem solving 2.2 Instructional data collection and compilation 2.3 Analytical planning (listening, communication, coordination, analysis, planning) 2.4 Computer applications (documentation, multi-media production, homepage production) 2.5 Project design and making (materials preparation, trimming, cutting, forming, grinding, joining, etc.) 2.6 Blueprint reading and drafting (manual drafting, CAD) 2.7 Tool manipulation 2.8 Design innovation **3. Others** 3.1 Time management 3.2 Safety and health	technology 2.4 Awareness of the importance of technology 2.5 Positive perception of the impacts of technology 2.6 Positive appraisal of technology 2.7 Willing to solve problems caused by technology 2.8 Interest in technological artifacts	research skills 2.3 Need to increase life-learning skills 2.4 Need to promote self-direction and growth skills 2.5 Need to increase skills of integrating mathematics, science and technology 2.6 Need to increase team-work and organizational learning skills 2.7 Need to increase project planning, analysis and management skills 2.8 Need to increase technical innovation skills

3.3 Communication and coordination 3.4 Organizational operation		

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